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Food Preservation: Using a Boiling Water Bath Canner

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Growth of the bacterium *Clostridium botulinum* in canned food may cause botulism—a deadly form of food poisoning. These bacteria exist either as spores or as vegetative cells. The spores, which are comparable to plant seeds, can survive harmlessly in soil and water for many years.

When ideal conditions exist for growth, the spores produce vegetative cells which multiply rapidly and may produce a deadly toxin within 3 to 4 days of growth in an environment consisting of

- a moist low-acid food,
- a temperature between 40°F and 120°F,
- and less than 2 percent oxygen.

Botulinum spores are on most fresh-food surfaces; however, because the spores grow only in the absence of air, they are harmless on fresh foods.

Most bacteria, yeasts, and molds are difficult to remove from food surfaces. Washing fresh food reduces bacteria numbers only slightly. Peeling root crops, underground stem crops, and tomatoes reduces bacteria numbers greatly. Blanching also helps reduce bacteria numbers, but the vital controls are the method of canning and making sure the recommended research-based process times are used.

The recommended processing times ensure the destruction of the largest expected number of heat-resistant microorganisms in home-canned foods. Properly sterilized canned food will be free of spoilage if the

lids seal and if the jars are stored below 95°F. Storing jars at 50°F to 70°F helps to maintain food quality.

FOOD ACIDITY AND PROCESSING METHODS

Whether food should be processed in a pressure canner or boiling-water canner to control botulinum bacteria depends on the acidity of the food. Acidity may be natural, as in most fruits, or added, as in pickled food.

- *Low-acid* canned foods are not acidic enough to prevent the growth of botulinum bacteria and must be processed in a pressure canner.
- *Acid* foods contain enough acid to block the growth of botulinum bacteria, or destroy the bacteria more rapidly when heated, and are often processed in a boiling-water bath canner.

pH is a measure of acidity; the lower the pH value, the more acidic the food. The acidity level in foods can be increased by adding lemon juice, citric acid, or vinegar.

- Low-acid foods have pH values higher than 4.6. They include red meats, seafood, poultry, milk, and all fresh vegetables except for most tomatoes.
- Most mixtures of low-acid and acid foods also have pH values above 4.6, unless their recipes include enough lemon juice, citric acid, or vinegar to make them acid foods.

- Acid (or acidified) foods have a pH of 4.6 or lower. They include fruits, pickles, sauerkraut, jams, jellies, marmalades, and fruit butters.
- Although tomatoes usually are considered an acid food, some are now known to have pH values slightly above 4.6. Therefore, if they are to be canned as acid foods, these products must be acidified to a pH of 4.6 or lower with lemon juice or citric acid. Properly acidified tomatoes and figs are acid foods and can be safely processed in a boiling-water canner.

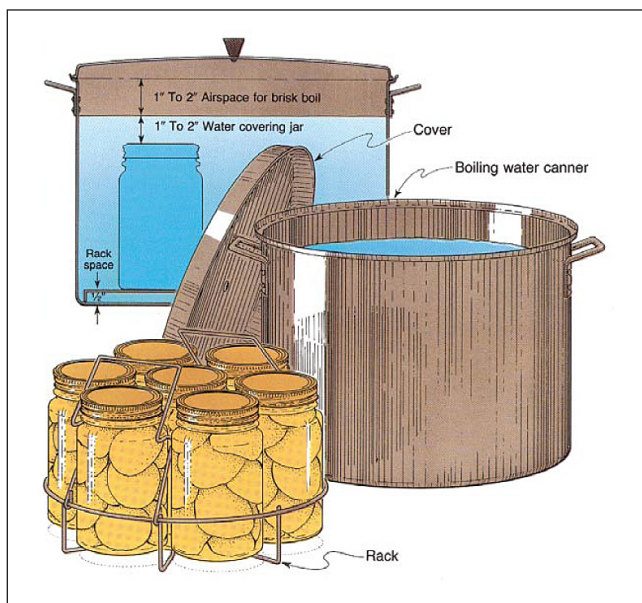
Botulinum spores are very hard to destroy at boiling water temperatures; the higher the canner temperature, the more easily the spores are destroyed. Therefore, all low-acid foods should be sterilized at temperatures of 240°F to 250°F, which are attainable with pressure canners.

Equipment needed for boiling water bath canning

A. Boiling-water canners

Boiling-water canners are made of aluminum or of porcelain-covered steel. They have removable perforated racks and fitted lids (fig. 1). The canner must be deep enough so that at least 1 inch of briskly boiling water will be over the tops of the jars during processing.

Figure 1. Boiling-water canner



Some boiling-water canners do not have flat bottoms. A flat-bottomed canner must be used on an electric range (ridged-bottomed canners are not efficient

on electric burners for maintaining the correct temperature for boiling water). Either a flat- or a ridged-bottomed can be used on a gas burner. To ensure uniform processing of all jars with an electric range, the canner should be no more than 4 inches wider in diameter than the element on which it is heated.

B. Jars

Food may be canned in glass jars or metal containers. Metal containers can be used only once (they require special sealing equipment, and they are much more costly than glass jars).

Regular and wide-mouth Mason-type threaded home-canning jars with self-sealing lids are the best choice. They are available in 1/2 pint, pint, 1-1/2 pint, quart, and 1/2-gallon sizes. The standard jar mouth opening is about 2-3/8 inches. Wide-mouth jars have openings of about 3 inches, making them more easy to fill and to empty. Half-gallon jars may be used for canning very acidic juices. Regular-mouth decorator jelly jars are available in 8- and 12-ounce sizes. With careful use and handling, Mason jars may be reused, requiring only new lids each time. When jars and lids are used properly, jar seals and vacuums are excellent and jar breakage is rare.

Most commercial pint- and quart-size mayonnaise or salad dressing jars may be used with new 2-piece lids for canning acid foods in a boiling water bath; however, you should expect more seal failures and jar breakage. These jars have a narrower sealing surface and are tempered less than Mason jars, thus they may be weakened by repeated contact with metal spoons or knives used in dispensing mayonnaise or salad dressing. Other commercial jars with mouths that cannot be sealed with 2-piece canning lids are not recommended for use in canning any food at home.

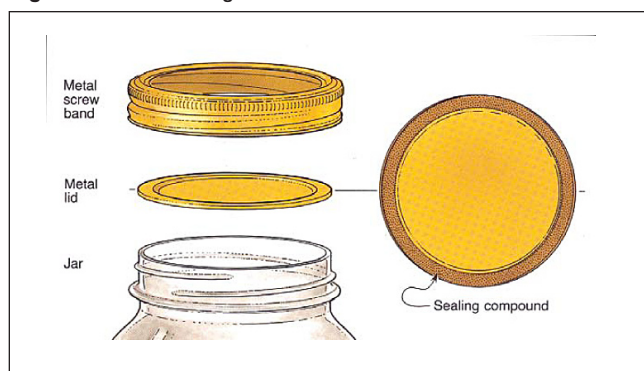
C. Lids

The common self-sealing lid consists of a flat metal lid that is held in place by a metal screw band during processing (fig. 2). When processing, the flat lid is filled with a colored gasket compound that softens and flows slightly to cover the jar-sealing surface, yet allows air to escape from the jar. The gasket then forms an airtight seal as the jar cools.

Buy only the quantity of lids you will use in a year. To ensure a good seal, carefully follow the manufacturer's directions in preparing lids for use.

Examine all metal lids carefully. Do not use old, dented, or deformed lids, or lids with gaps or other defects in the sealing gasket.

Figure 2. Self-sealing lid



D. Small canning utensils

A variety of specially designed utensils for canning are available for purchase that are very useful in home canning: jar funnel, jar lifter, plastic wand or spatula, lid wand, and others. The jar funnel and the jar lifter are often considered essential.

Using boiling-water canners

Follow these steps for successful boiling-water canning:

1. Before preparing food, fill the canner halfway with clean water; this is approximately the water level needed for a canner load of pint jars. For other sizes and numbers of jars, the amount of water in the canner will need to be adjusted so it will be 1 to 2 inches over the top of the filled jars.
2. Preheat water to 140°F for raw-packed foods and to 180°F for hot-packed foods. Food preparation can begin while the water is preheating.
3. After filling jars and wiping sealing ring with a clean damp cloth, fingertip-tighten the lids—do not screw the lid on tight. Follow manufacturer's directions.
4. Load filled jars, fitted with lids, into the canner rack and use the handles to lower the rack into the water; or fill the canner with the rack in the bottom, one jar at a time, using a jar lifter. When using a jar lifter, make sure it is securely positioned below the neck of the jar (below the screw band of the lid). Keep the jar upright at all times. Tilting the jar could cause food to spill into the sealing area of the lid.
5. Add more boiling water, if needed, so the water level is at least 1 inch above jar tops. For process

- times over 30 minutes, the water level should be at least 2 inches above the tops of the jars.
6. Turn heat to its highest position, cover the canner with its lid, and heat until the water in the canner boils vigorously.
7. Set a timer for the total minutes required for processing the food.
8. Keep the canner covered and maintain a boil throughout the process schedule. The heat setting may be lowered a little as long as a complete boil is maintained for the entire process time. If the water stops boiling at any time during the process, bring the water back to a vigorous boil and begin the timing of the process over, from the beginning.
9. Add more boiling water, if needed, to keep the water level above the jars.
10. When jars have been boiled for the recommended time, turn off the heat and remove the canner lid. Wait 5 minutes before removing jars.
11. Using a jar lifter, remove the jars and place them on a towel, leaving at least 1-inch spaces between the jars during cooling. Let jars sit undisturbed to cool at room temperature for 12 to 24 hours.

Adjusting for altitude

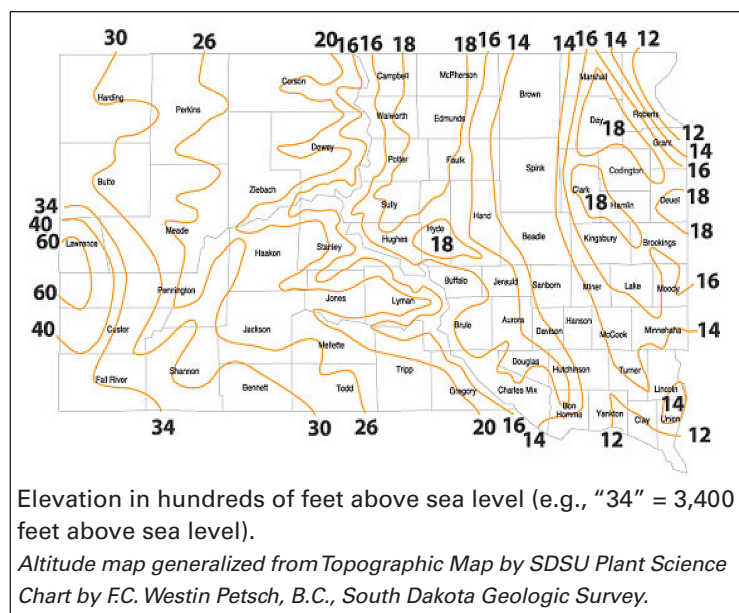
If you live at altitudes of 1,000 feet or more, using the process times for canning food at sea level may result in spoilage or foodborne illness from microorganisms. Water boils at lower temperatures as altitude increases. Lower boiling temperatures are less effective for killing bacteria. Increasing the process time compensates for lower boiling temperatures.

South Dakota's altitudes range from 1,200 feet to 6,000 feet above sea level. North Dakota's altitude range is from 800 to 3,000 feet above sea level. Refer to the South Dakota and North Dakota altitude maps (fig. 3 and 4) to identify your altitude. The recommended altitude adjustments are in Table 1.

Table 1. Altitude adjustments for boiling water bath canning

For altitudes above 1,000 feet, adjust the recommended processing times as indicated below.	
Altitude (feet)	Increase process time
1,001–3,000	5 minutes
3,001–6,000	10 minutes
6,001–8,000	15 minutes

Figure 3. South Dakota altitude map



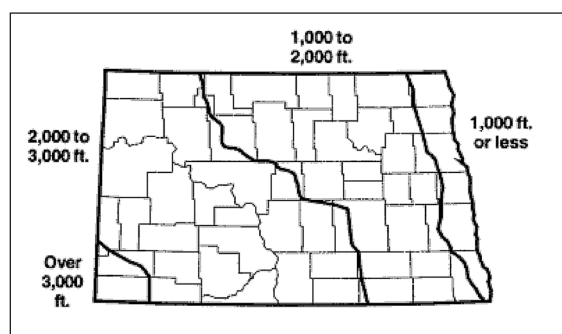
For more information, contact your local Extension office or visit the following Web sites:

- SDSU Extension Service: <http://extfcs.sdstate.edu/foodsafety/site/index.cfm>
- NDSU Extension Service: www.ag.ndsu.edu/foodmenu/storage.htm

ACKNOWLEDGEMENT

This Extension Extra is adapted from *USDA Complete Guide to Home Canning*, 2006. Agricultural Information Bulletin Number 539. http://www.uga.edu/nchfp/publications/publications_usda.html.

Figure 4. North Dakota altitude map



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